Fire Management notes

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FIREFIGHTER SAFETY & HEALTH

United States Department of Agriculture
Forest Service

"Zero Tolerance" memo to all employees from Secretary of Agriculture Dan Glickman and Secretary of the Interior Bruce Babbitt.

Dan Glickman

Bruce Babbitt

THE SECRETARY OF AGRICULTURE — WASHINGTON — THE SECRETARY OF THE INTERIOR

TO ALL EMPLOYEES

1994 was a tragic year for wildland fire. Even more sobering is that without the judgment and commitment to safety demonstrated by firefighting personnel throughout the Nation, our losses could have been even greater. Important lessons were learned, including an affirmation that agency personnel at all levels, and not just those directly involved in fire suppression, must demonstrate a commitment to safety.

We are committed to "Zero Tolerance" of carelessness and unsafe actions. The commitment to and accountability for safety is a joint responsibility of firefighters, managers and administrators. No resource or property values are worth endangering people. All land management plans and all suppression plans and actions must reflect this commitment. Individuals must be personally committed and responsible for their own performance and accountability.

Please join us in adopting firefighting's code of safe practices:

Safety Comes First on Every Fire, Every Time.

The Ten Standard Fire Orders are Firm. We Don't Break Them; We Don't Bend Them.

All Firefighters have the Right to a Safe Assignment.

Every Firefighter, Every Fireline Supervisor, Every Fire Manager, and Every Agency Administrator has the Responsibility to Ensure Compliance with Established Safe Firefighting Practices.

Secretary of Agriculture — Secretary of the Interior

This issue of *Fire Management Notes* is the first of two focusing on the safety and health of wildland firefighters. Readers may also wish to read back issues of this publication for other discussions of these important topics—in particular, volume 51, no. 2. Many thanks to all who contributed information and shared their experiences with the fire community. Special thanks goes to David "Shag" Aldrich, safety and training officer on the WO Fire and Aviation Management Staff, for his advice and help during the production of these issues.

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On the Cover:

Entrapped firefighters deploy their fire shelters in a survival zone during the Shelly incident in 1989 on the Gila National Forest in New Mexico. Photo: Mark Erickson, Silver City, NM, ©1995.

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Establishing an Effective Safety and Health Program for Firefighters

Stephen J. Yellstrom

A year has passed since the South Canyon Fire took the lives of 14 firefighters in the mountains of Colorado. Since then, members of the firefighting community, including the United States Department of Agriculture Forest Service, Department of the Interior Bureau of Land Management, and Department of Labor Occupational Safety and Health Administration (OSHA) have asked two very important questions: Why did this tragedy happen, and how can we prevent a similar tragedy in the future? The first question has been answered as a result of the excellent work done by all those involved in the South Canyon Fire Investigation. There was no **one** cause of this accident but rather a combination of poor communication, a breakdown in management oversight, and lack of hazard recognition, which was catalyzed by adverse environmental conditions into a disaster.

Obviously, dry fuels, steep terrain, and strong winds are some of the uncontrollable factors that many of the existing firefighting safety guidelines are designed to address. What we need to examine now are the human factors, or the controllable variables, that we must change if we are to avoid another "South Canyon" in years to come. One blueprint that would channel the human factors or attitudes in the direction of positive change might include these parts: management commitment, employee involvement, and periodic audits.

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> "OSHA remains committed to assisting wildfire fighting agencies in any way possible to reach our mutual goal—to reduce the risk to our firefighters."

Management Commitment

Everyone agrees that firefighting is an inherently dangerous activity and that it is the responsibility of all involved to reduce the risk to the lowest possible level. Managers associated with wildfire suppression attempt to reduce this inherent risk through training, written procedures, personal protective equipment, and changes brought about through accident investigation. These are all necessary components of a successful safety and health program, but what are the subtle messages given to firefighters on a day-to-day basis regarding safety's place in the overall mission? For example, when an initial attack Incident Commander and crew return from a Type 4 fire that had been quickly and efficiently extinguished, the members are likely to be greeted with handshakes, pats on the back, and congratulations for a job well done. Would the same team be so warmly received if they abandoned a fire that they perceived to be unacceptably risky? If the answer is no, than the unmistakable message that is sent to firefighters is that putting out the fire is the highest priority and that safety, although important, is secondary. If safety truly is the firefighters' most important mission, then wildfire managers must reinforce this message through their actions every day.

Employee Involvement

Employees are the primary beneficiaries of any successful safety and health program, but all too often, their only role in the development of the program is to implement policies that are already cast in stone. Who knows better than the front-line firefighters what really happens on the fires that are fought each day of the fire season? Employees are an often overlooked resource in the development and evaluation of safety programs. Front-line firefighters should be included as members of local safety and health committees, as members of planning and policy-setting groups, and as members of any accident investigation team.

Periodic Audits

Firefighting safety is a dynamic process that requires adjustment,

fine tuning, and maintenance. An auditing process is essential to ensure that the desired safety policies, procedures, and attitudes are translated into reality in the field. An effective audit should consist of more than employee interviews, questionnaires, reviews of training records, or putting check marks on a post-fire evaluation form. On-site evaluations of firefighters' performance on all types of fires are essential to determine the effectiveness of the overall safety and health program. Knowledgeable and technically qualified individuals should conduct on-site evaluations, and their focus should be on how Incident Commanders accomplish their primary assignment—safety. Incident Commanders who fight fires safely should be recognized appropriately; necessary corrective action should also be promptly taken.

A question often asked of OSHA is, "How often should a safety and health program be audited?" If we were to think of safety and health goals as an item produced by a manufacturing plant, then the answer would be easy. Conduct on-site audits as often as necessary to assure a quality product (safety) is the ultimate outcome. The number and frequency of the audits should depend on what is found on the front lines.

There is no one simple or correct method to develop and implement an effective safety and health program. Any framework, including this one, must be customized to reflect the unique working conditions and people involved. Fire managers who regard management commitment, employee involvement, and periodic audits as essential components to consider in fulfilling their commitment to firefighting safety will be headed in the right direction. OSHA remains committed to assisting wildfire fighting agencies in any way possible to reach our mutual goal—to reduce the risk to our firefighters. ■

Dear Firefighters:

The 1994 fire season started early and ran late—requiring 6 months of extremely active firefighting. It was a year of great success and deep tragedy. The memory of those firefighters and friends we lost is deep in our hearts.

These are "defining" times. Congress and the public are challenging all Federal agencies to pare down their operations and scrutinize all policies that affect the economy and the environment.

As we do this at the USDA Forest Service, I want to share with you some of the key issues we are facing in the fire management arena. The 1994 fire season really drove home the challenges we face and the directions in which we need to be heading.

As partners, we must come to terms with the tough decisions that we have to make regarding how we'll use our limited resources, what role forest management can and should play in reducing wildfire risk, and how to deal with fire management and suppression in the wildland-urban interface.

We must help the American people understand that fire management and forest health are issues without boundaries, involving all public and private lands—urban, rural, and wildland. Together we have to find solutions.

Most important as we look toward the future is to keep in mind **firefighter safety**. The safety of everyone in fire management operations must continue to be our paramount concern. This concern must be there at all times—as we make our plans, carry them out, and evaluate them. We must clearly and repeatedly communicate the responsibility that each individual firefighter and line manager holds. This issue of *Fire Management Notes*, devoted to safety and disseminated to wildland firefighters across America, is one of the ways we are facing the challenge of communicating this concern.

James R. Lyons

I have no new words of wisdom to convey the importance of firefighter safety. All the words have been said and, sadly, so have the eulogies.

Firefighting is a high-risk calling. Let's dedicate our future efforts to honor those who so bravely have served on the Nation's firelines in the past and in memory of those we lost in 1994. In fact, in the future, let us redouble our efforts to make the work of fighting wildfires as safe as it can be.

Best personal regards.

James R. Lyons
Under Secretary
Natural Resources and Environment

Firefighter Safety in Changing Forest Ecosystems

Jerry Williams

Following the magnitude of human loss that we experienced in 1994 and the severity of wildfires that we have witnessed since 1985, the USDA Forest Service is re-examining the factors that predispose the onset of severe wildfires and, sometimes, tragedy.

> Unless we accept that the costs and risks involved in using prescribed fire to treat fuels are far less than the consequences of inaction, we will leave the next generation of firefighters at more serious risk than this generation has been.

We are very aware that many of America's forests are not as healthy as they were 100 years ago. We are also aware that the firefighters' fire behavior environment may not be as safe as it was 100 years ago, particularly in long-needle pine and other short-interval, fire-adapted ecosystems.

In the West, long-needle pine ecosystems comprise ponderosa pine, sugar pine, white pine, and Jeffrey pine; in the South, the species are loblolly, short-leaf, long-leaf, and slash pine. In fact, these species range across about 30 percent of the acres under USDA Forest Service protection. Figure 1 shows the general distribution of these species in the continental United States.

Of course, wildfires occur in a wide variety of fuel types and any one of them can be dangerous. However, many of today's most significant wildfires are, paradoxically, occurring in those ecosystems where fire was historically most benign. Wildfires named Tyee, Foothills, Fountain, Black Tiger, Aubrey Hall, Hangman Hills, and Dude are but a few that, within the past decade, have all occurred in long-needle pine ecosystems. These recent wildfires are far different from the kind of fire witnessed a century ago. Then periodic fires turned back encroaching small trees and other less fire-tolerant species. These fires were generally low intensity and, although they could be fast moving, were far less severe, less threatening, and much less damaging than the fires we see on these same sites today.

In the past several years, we have learned that these ecosystems benefit from periodic, low-intensity fire. Prior to settlement, fire played an essential role in regulating long-needle pine stands. In the prolonged absence of surface fire, these stands have undergone significant changes in species composition and structure which, in turn, have predisposed them to severe wildfire (Gruell 1983). Figures 2 through 5 show the dramatic change that has occurred in one of these stands on the Bitterroot National Forest in western Montana between 1909 and 1989. Notice the accumulation of understory biomass. Today, under the influence of drought, many of the encroaching understory species have died and, as standing dead fuel, further exacerbate the chance that wildfires in

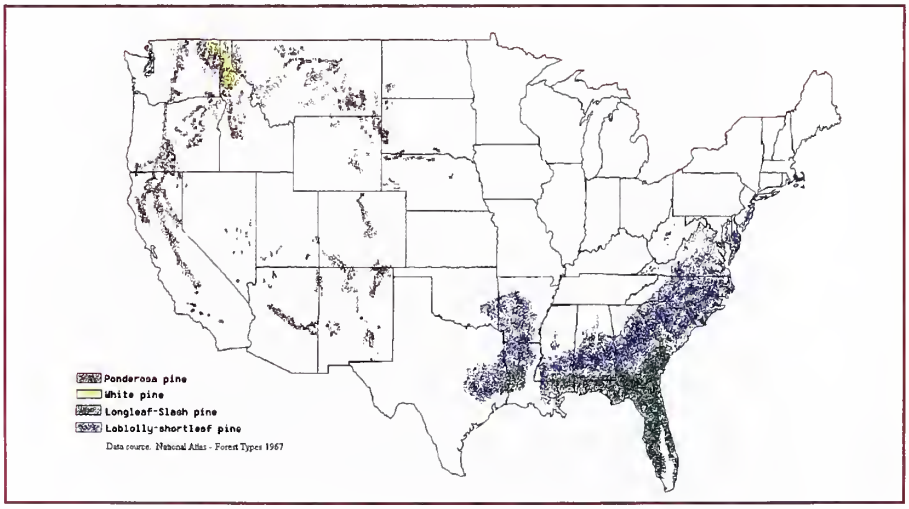

Figure 1—*General distribution of long-needle pine types in the continental United States.*

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these ecosystems can be devastating.

Fire-adapted forests have been so drastically transformed by the combined effects of overstory logging, grazing, and fire exclusion that the very character of fires in these ecosystems has changed. In this 100-year period, the forest has changed and fire behavior characteristics have changed too. Low-intensity stand maintenance burning, common a century ago, has been displaced by severe, stand replacement burning today (Williams and Rothermel 1992). Figure 6 shows the change in fire behavior characteristics over time on the same site as forest stand characteristics become more dense in the understory.

Today, the Forest Service uses prescribed fire on about 450,000 acres (182,110 ha) per year to reduce fuel loadings. It is estimated that we need to treat some 3,000,000 acres (1,214,000 ha) per year in long-needle pine types alone to more closely approximate the more natural, less severe fire cycle.

Since the tragedies of the fire season of 1994, we have had a long period of mourning, reflection, and introspection within the wildland fire community. As we strengthen our resolve to improve firefighter safety, we need to be mindful of the factors that set the stage for catastrophe. Our ability to change fuel flammability characteristics is an important safety element we must not overlook. Hazard abatement techniques, including prescribed fire, need to be more fully integrated into our land management practices.

Fuel treatment is as important to ensuring firefighter safety as is adherence to the 10 Standard Fire Orders or the correct use of Nomex

Figure 2—*This 1909 photo of Lick Creek on the Bitterroot National Forest in Montana shows an open ponderosa pine stand. Fire scars showed a mean fire interval of 7 years between 1600 and 1900. Photo: W. J. Lubken, USDA Forest Service, 1909.*

Figure 3—*The camera point in 1947 replicated the original position on Lick Creek. Photo: USDA Forest Service, 1947.*

Figure 4—*Once again the camera point was replicated in 1979, showing that wildfire exclusion allowed ponderosa pine and Douglas fir to become established and develop into a dense understory. The large ponderosa pine in the 1909 and 1947 photos was cut—as were other trees—during harvests in either 1952 or 1962. Photo: W. J. Reich, USDA Forest Service, 1979.*

Figure 5—*The Lick Creek photo point as it appeared in 1989; note the accumulation of understory biomass. Photo: USDA Forest Service, 1989.*

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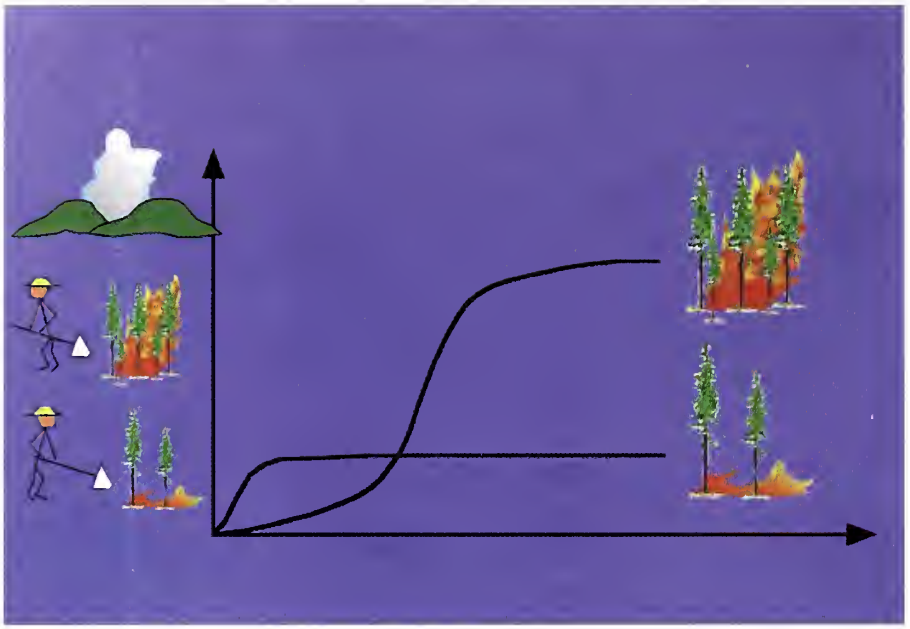

Figure 6—*A comparison of fire dynamics between fire-maintained and fire-excluded long-needle pine types.*

protective clothing and fire shelters. It is time we accept that the costs and risks involved in using prescribed fire to treat fuels are far less than the consequences of inaction. To do anything less will leave the next generation of firefighters at more serious risk than this generation has been.

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Safety First—Every Fire, Every Time

As we reflect on the 1994 fire season and other recent and past devastating wildland fires, firefighter safety stands out as a major concern. But this concern is not a temporary phenomenon—we all know that safety is an ongoing responsibility. It is not "someone else's" job nor the province of a single staffing area. Because the USDA Forest Service is responsible for about 80 percent of the wildland firefighting business, our agency must take primary responsibility for firefighter safety.

We all know why we fight fires on our wildlands—to protect lives, property, and resource values. "Protecting lives" always comes first—and those lives include those of our firefighters. In the future, as the Secretary of Agriculture and Secretary of the Interior have stated elsewhere in this issue of *Fire Management Notes*, we will have "zero tolerance" for unsafe behaviors and activities during fire suppression operations that can cause (or have caused) accidents. As we focus on firefighter safety, it is paramount that these safe practices become a "Firefighter Code of Conduct."

In 1937, David Godwin, national fire director for the Forest Service, said that in our "control of forest fires some accidents will occur—just as in city fire protection—without fault or failure on the part of anyone." While he was certainly correct that there are many hazards associated with wildland fire operations, we can ensure that our firefighters are 100 percent prepared. They must have the best equipment available and be thoroughly trained to carry out their mission.

We all know that our agency is undergoing great changes in the downsizing and restructuring process. As we make decisions, we must consider the safety of our workforce in future fire seasons. As is appropriate for our agency, all of our employees help protect our natural resources. Now and in the future, more of us must be prepared to support fire emergencies when they occur. We must have capable leadership, astute management, and well-qualified personnel. We can do nothing less.

Jack Ward Thomas

I wish you well in your firefighting responsibilities in the future.

Jack Ward Thomas

Jack Ward Thomas, Chief

Personal Protective Equipment in Wildfire Entrapments[1]

Richard J. Mangan

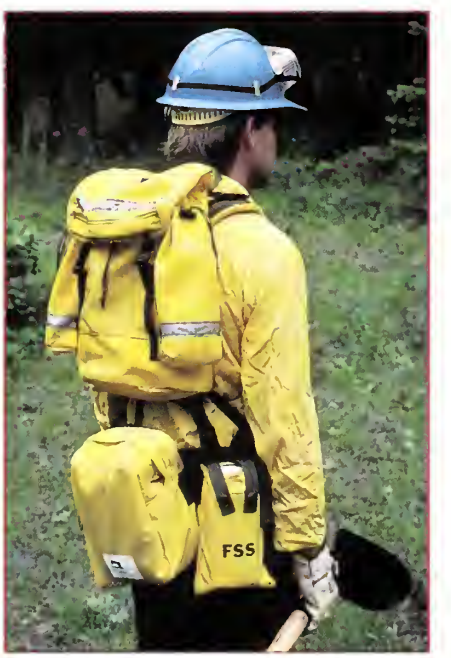
Missoula Technology and Development Center (MTDC) fire equipment specialists routinely investigate wildland fire entrapments to ensure that firefighting equipment and techniques are appropriate. In 1993 and 1994, these specialists investigated entrapments in Arizona, California, Colorado, Georgia, and New Mexico and made some important observations about the performance and use of personal protective equipment (PPE). They also generated some recommendations for proper use of PPE to avoid injury. While sizes, locations, fuel types, and burning conditions of wildland fires vary across the United States, similarities in the use of PPE allow all firefighters to benefit from a review of these entrapments.

MTDC evaluates protective equipment and techniques to ensure firefighter safety.

Fire Shelters

Fire shelters were used to protect some firefighters from high levels of radiant heat in the entrapments. Information gathered from the MTDC investigations includes:

- Firefighters are still trying to outrun flame fronts while carrying heavy packs. They are seldom successful. When entrapment is imminent, firefighters must get shelters out and get rid of packs, which slow up escape and deployment and may ignite on firefighters.
- As they walked along a narrow jeep trail above the fire, five individuals used their partially opened fire shelters as heat shields. They did not fully deploy their shelters in the recommended manner and may have endangered themselves by being in a zone where super-heated air and gases could have damaged their respiratory systems. Their fire shelters provided clearer air and shielded them against some of the radiant heat.
- Many individuals traveling along roads to larger safety zones inhaled harmful amounts of smoke and subjected themselves to radiant heat without deploying their fire shelters as shields.
- Individuals attempting to outrun a flame front moved through excellent shelter deployment sites without recognizing them.
- Both a jeep trail 8 feet (2.4 m) wide and a forest road 16 feet (4.9 m) wide provided adequate areas to safely deploy fire shelters.
- Some individuals deployed their shelters in areas subject to direct flame contact and extremely high temperatures, conditions that exceeded the design criteria of the shelters. The shelters failed to protect them.
- Several individuals deployed their fire shelters perpendicular to the flame front rather than parallel, increasing the surface area subjected to radiant heat and reducing the value of the shelter.
- A fire shelter with a 3-foot (91-cm) tear, caused by a person trying to get under another's shelter, provided adequate protection for the entrapped firefighters.



George Jackson, fire equipment specialist at MTDC, displays thermal protective clothing and PPE including hardhat, Nomex clothing, leather gloves, and fire shelter. Photo: Jim Kautz, USDA Forest Service, MTDC, Missoula, MT, 1990.

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[1]This article, in part, was first published as "Lessons Learned: The Use of Personal Protective Equipment on Wildland Fire Entrapments in 1993" in the April 1994 issue of *Fire Tech Tips*, published by the USDA Forest Service's Technology and Development Program, Missoula, MT.

- Two individuals survived under one fire shelter (without injuries) when one person was unable to deploy his shelter quickly enough.
- Several fire shelters showed some sign of wear inside the clear polyvinyl bags but performed satisfactorily in use. However, these shelters had not been properly inspected.
- Several entrapped firefighters failed to have their fire shelters with them on the fire.
- People are still failing to lie on the ground before the flame front catches them. The air within 18 inches (46 cm) of the ground is often sufficiently cool to protect the respiratory system even when no fire shelter is used.
- Several individuals wore gloves that were too bulky to allow them to remove shelters from the carrying case without removing their gloves; others had oily gloves that slipped when they tried to pull the tabs on their fire shelter case.

Other Personal Protective Equipment

The MTDC investigators learned the following about the performance of other items of PPE on these entrapments:

- Several individuals who attempted to outrun the fire on steep slopes lost their hardhats because they were not using the chin straps. Hardhats provide critical thermal protection for the head and reduce direct exposure to radiant heat or actual flame.
- Nomex shirts and overpants on several individuals were subjected to temperatures in excess of 600 °F (316 °C). These items functioned as designed and provided thermal radiation protection.
- Radiant heat in the 400-600 °F (204-316 °C) range will not damage line gear. Some damage and burning occurred when flammable items such as fusees or saw gas containers, left in the firefighter's field pack, caught fire. Fusees will self-ignite at 375 °F (191 °C); the igniter portion burns at 3,300 °F (1,820 °C) and the main portion of the fusee continues to burn at 1,600 °F (870 °C). These temperatures far exceed the design limitations of the PPE.
- All individuals entrapped were wearing cotton or cotton/polyester mix t-shirts; both short-sleeved and long-sleeved versions were used. Although charring occurred, none of these items ignited. The extra insulation between the Nomex outer shirt and the firefighter's skin reduced burn injury by about 15 percent.
- Some individuals wore military Nomex flight suits on the fireline. These garments do not offer adequate levels of protection from radiant heat and are not NFPA-1977 compliant.
- One individual who did not deploy his fire shelter had his face and neck shroud tucked inside his hardhat and failed to let it down when entrapped. He suffered minor burns to his ears when the fire burned by him.
- Close-fitting face and neck shrouds restrict breathing and are uncomfortable. The lack of an insulating air layer between the shroud and skin increases the heat load the wearer suffers and can lead to burns from direct contact with the shroud or from radiant heat. At least one firefighter was so uncomfortable while running from the fire that he opened the shroud to breath more easily.
- One individual did not wear gloves while constructing fireline; when he tried to outrun a quick-moving flame front, he received third-degree radiant burns on his hands.

Jim Kautz photographing PPE used in a 1993 fire entrapment on the Buchanan fire, Santa Fe National Forest. Photo: Dick Mangan, USDA Forest Service, MTDC, Missoula, MT, 1993.

- Leather lace-up boots provided good protection for entrapped firefighters. No burn injuries to the feet occurred when exposure was in the protection range of the other PPE. One person wore plastic boots, which are hazardous in a fire environment, do not meet minimum safety standards, and may contribute to foot injury.

Recommendations

While wildland firefighters do not expect to be entrapped on fire assignments, the possibility always exists. To minimize injuries, firefighters must plan their reactions in case of entrapment. Following are some recommendations for actions that could be critical for survival:

- Select escape routes and safety zones carefully. Consider the potential rate of fire spread and the fire intensity of the fuels to allow sufficient time to escape.
- Always use all assigned PPE in the method intended (e.g., sleeves down on shirts and gloves on).
- When entrapped with no escape route, lie face down on the ground where cooler air will help protect your airway, even if you cannot get into your fire shelter. Before the high heat arrives, be inside your fire shelter.
- During an entrapment, always remove all flammable materials such as fusees, saw gas containers, and oil-soaked packs immediately, even if you must complete removal while you are lying on the ground or in your shelter. Push your pack well away from others and yourself.
- Never begin an operational period with clothing or PPE that has gas, oil, or other flammable materials on it.

Ted Putnam, MTDC fire equipment specialist, examines PPE during an investigation after the Glen Allen fire on the Angeles National Forest in 1993. During an entrapment at this site, two firefighters were killed and two were severely burned. Photo: Dick Mangan, USDA Forest Service, MTDC, Missoula, MT, 1993.

- Always carry your fire shelter where it can be quickly reached, even if you are on the run. Never carry your shelter inside your field pack.
- Inspect your fire shelter annually at the start of each fire season, and reinspect it regularly (every 2 weeks) throughout the fire season. Specific information on inspecting fire shelters can be found in the publication "Inspecting your Fire Shelter," available from the address at the end of this article.
- Practice deployments. you should be able to properly deploy and be within your shelter in less than 25 seconds. Practice sites should include steep, uneven ground. Use large fans to simulate the high wind conditions that often occur on wildland fire entrapments.
- Refresh your fire shelter training every year and completely retrain every 3 years.
- A shelter may prevent minor burns and smoke inhalation. In extremely smoky conditions, deploy the shelter and lie on the ground to minimize smoke inhalation, even when burn injury is unlikely.
- If no other alternative exists, share a fire shelter with another firefighter.
- Do not wear face and neck shrouds on a regular basis; they cause heat stress and may tempt you to take more chances. Wear them when previously safe conditions worsen and when escape or entrapment action becomes likely.

MTDC will continue to evaluate protective equipment and techniques to ensure firefighter safety. Remember, following these recommendations could save your life! For additional information, contact Dick Mangan, MTDC, Bldg. 1, Ft. Missoula, Missoula, MT 59801; tel. 406-329-3949; Fax 406-329-3719. ■

A Potential Life Saver—Training With a Practice Fire Shelter

Kevin Lee

Why Train With a Practice Shelter?

Firefighters must rely on tools at hand on the fireline. However, if they haven't received sufficient training, they won't be able to use these tools effectively. Prior training with a practice fire shelter ensures that the firefighter maximizes the effectiveness of the one tool that is a proven lifesaver. Hundreds have been saved from injury or death through the proper use of the fire shelter.

Using a practice fire shelter and materials mentioned in the accompanying article during training can help firefighters deploy their fire shelters quickly and safely during wildland firefighting.

Wildland firefighting is an inherently dangerous activity. Fuel types, topography, weather, time of day—these are just a few factors that play a major role in the behavior of a particular fire. With so many variables—some changing drastically from minute to minute—the potential for a life-threatening event occurring during the suppression of a wildland fire is very real. When seconds count, firefighters faced with a fire entrapment must be able to deploy their fire shelters quickly and effectively. Hundreds have already been saved from injury or death through the proper use of the fire shelter.

In order to ensure that firefighters are safely inside their fire shelter within 25 seconds, they must receive sufficient training to make the deployment procedure automatic. Only one training technique adequately provides this: practice deployments. By repeatedly practicing the procedure, the firefighter soon becomes more proficient at getting the shelter deployed and getting inside. Firefighters have long needed a shelter that allows practice deployment, and it is now available.

A comparison of an actual fire shelter with a practice fire shelter (in orange case). The practice shelter, reusable during repeated practice sessions, enables firefighters to get sufficient training in shelter deployment. Photo: Jim Kautz, USDA Forest Service, MTDC, Missoula, MT, 1994.

Why Practice Shelter Training Is Essential

Using an actual fire shelter for training poses several problems. Once a fire shelter has been removed from its plastic container and unfolded, it cannot be adequately refolded and put back in

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the case. Also, folding and refolding a fire shelter soon causes cracking and tearing along fold lines. After a relatively few uses, the fire shelter is worthless, even as a training tool. In addition, using fire shelters for training is very expensive.

The Missoula Technology and Development Center (MTDC) has addressed this concern by taking a practice fire shelter designed by the California Department of Corrections and the California Department of Forestry and Fire Protection and preparing drawings and specifications for the procurement of a standardized practice fire shelter. The practice shelter is available in the 1995 *GSA Wildland Fire Catalog* for $30.54 including shelter, liner, and case. Ordering information: NFES #2407; NSN 6930-01-387-8543.

Attributes of the Practice Shelter

The practice fire shelter is made of polyethylene, which will allow for repeated use (estimated 50-75 times). It folds back to its original size, readily slipping back into the protective inner bag. The inner bag is constructed of the same polyvinyl material as the protective inner bag for fire shelters, but the polyvinyl is thicker and has a Velcro closure instead of a tear strip. The Velcro ring pull is a continuous strip and can be opened from either side of the inner bag, reflecting the design modification in the fire shelter inner bag.

The newer fire shelters have polyvinyl inner bags with ring-pull tear strips that encircle the bag. With an initial cost comparable to a fire shelter, the practice fire shelter is a cost-effective solution to an important training need.

One of the publications about using fire shelters properly that is available from NIFC in Boise, ID. Photo: Jim Kautz, USDA Forest Service, MTDC, Missoula, MT, 1994.

The practice fire shelter has an international orange outer container that is clearly marked "Practice Shelter," eliminating the chance of confusing it with the yellow-encased fire shelter. Although constructed from a different material than the fire shelter, the practice fire shelter shakes out and unfolds with the same "feel" as a fire shelter.

Other Shelter Training Materials Available

When combined with reading and viewing materials produced by MTDC concerning fire shelters, the practice fire shelter is the perfect hands-on training tool. "Your Fire Shelter" (PMS 409-1/NFES 1570 (In press), "Your Fire Shelter Beyond The Basics" (Facilitator's Guide PMS 409/NFES 2179, May 1995), and the older video "Your Fire Shelter" (PMS 409/NFES 1568, 1986) are excellent guides to the correct fire shelter use. They explain the proper methods for effective fire shelter use and training techniques, stressing many important points such as:

- Getting down low, even before you deploy your shelter or, for that matter, even if you have no shelter. Remember the optimal survival zone is within a foot (30 cm) of the ground with or without a fire shelter.
- Getting rid of flammable materials (fusees, saw gas, etc.) including after you are inside the shelter.
- Using large fans and steep terrain to add realistic conditions to the training.
- Employing the technique of visualization to enhance the learning process.

These materials are readily available through the National Wildfire Coordinating Group (NWCG) Publications Management System Unit. Orders may be mailed or faxed to: National Interagency Fire Center (NIFC); Attn: Supply; 3833 South Development Avenue, Boise, ID 83705-5354; Fax: 208-389-2573/2548.

For more information or to ask any questions regarding the practice fire shelter, contact Ted Putnam, MTDC, Bldg. 1, Ft. Missoula, Missoula, MT 59801 or telephone 406-329-3900. His electronic mailing address is FSWA/S=T.Putnam/OU=R01A@ATTMAIL.COM and his Fax is 406-329-3719. ■

Human Decisionmaking in the Fire Environment

Curt C. Braun and Buck Latapie

"Fight fire aggressively, but provide for safety first" not only represents the first Standard Fire Order but also characterizes the drive to advance suppression technology. Toward this goal, considerable gain has been achieved in areas of aviation, fire prevention, suppression tactics, fire behavior, and equipment technology (Wilson 1989). Although substantial energy has been dedicated to understanding the nature of fire, these efforts have been clearly skewed in favor of what might be considered the more tangible aspects of fire (e.g., fuel models, fire behavior, suppressing chemicals, and use of equipment). Today, firefighters possess a greater knowledge and understanding of fire behavior, suppression tactics, retardant effectiveness, equipment use, and weather prediction than ever before. Yet firefighters themselves are one aspect of the fire environment that has received disproportionately less attention.

A survey of the relevant literature revealed few writings concerned with the human aspect of suppression. For example, the report of Haven et al. (1982) examining the production rates of hand crews relied solely on qualities of the fire. Production rates were based upon factors such as the fuel's resistance-to-control classification and fire location. This report does not consider the inherent qualities of the crew that might influence production.

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Although we would like to think that humans are efficient and accurate decisionmakers, research clearly shows that human decisionmaking can be less than perfect; stress has been shown to adversely influence decision quality in a variety of ways.

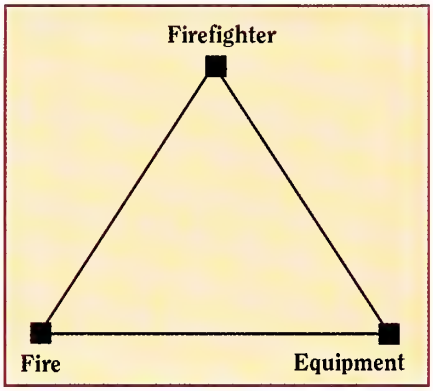

Figure 1.—*The fire suppression triangle.*

The Suppression Triangle

Efficient fire suppression contains three components, all of which contribute to the success or failure of a suppression effort: the fire environment, equipment, and firefighters (see fig. 1). In the suppression triangle, "equipment" can range from hardhats and shovels to bulldozers and air tankers. "Fire" ranges from fire basics to complex fuel and spread models. "Firefighter" comprises aspects of individuals and crews, ranging from physical fitness to training. Although this representation is rather arbitrary, it serves three purposes:

- It divides the larger fire suppression task into elements that can be more closely examined.
- It clearly differentiates the firefighter from the equipment.
- Most importantly, it identifies the human as integral to all suppression efforts.

Of the three components, the least emphasis has been placed on the human. The difficulties associated with identifying and understanding factors that influence human behavior, however, should not imply that they are insignificant or inconsequential. On the contrary, the human represents the single largest aspect of fire control (besides Mother Nature) that influences the success or failure of all fire suppression. One aspect of the human that has the greatest potential to affect the success or failure of a suppression effort is decisionmaking. Here we focus on the decisionmaking process and identify characteristics of humans that might influence the quality of the decisions we make.

Characteristics of Human Decisionmaking

Everyone involved in firefighting is a decisionmaker. An overhead team must decide among suppression strategies. Division supervisors must decide how to deploy resources. Crew superintendents must decide how long their crews should stay in deteriorating conditions. Finally, individual firefighters might have to decide if a burning root poses any threat of crossing the line.

Although we like to think that humans are efficient and accurate decisionmakers, research clearly shows that decisions can be adversely influenced by certain decisionmaking processes that are efficient but imperfect. Unlike computers that make decisions based upon systematic algorithms, human decisionmaking is commonly based on general rules-of-thumb called heuristics. An example of a heuristic is the mnemonic "right is tight; left is loose." In the majority of situations, mechanical objects have right-handed threads and are consistent with the rule. However, sometimes the rule fails. The small propane tank on certain kinds of outdoor barbecues has a left-hand thread; thus the heuristic would tighten rather than loosen fitting. What heuristics lack in accuracy, however, they compensate for in efficiency. By remembering a simple rule, we can assemble or disassemble the majority of mechanical objects.

It is unlikely that the safety of a firefighter would be jeopardized by an inability to disconnect a propane tank from a barbecue. This example, however, reflects the fact that human decisionmaking is not as systematic as expected. There are at least three decisionmaking situations in the fire environment that might be particularly susceptible to these human imperfections: decisions requiring the integration of multiple pieces of information, decisions made without feedback, and decisions made under stress.

Integrating Multiple Pieces of Information

It seems reasonable to think that having more information leads to better decisions. Yet most decisions are made with only a few pieces of information, independent of what information is available (e.g., how much information do most people have when deciding to purchase a specific car?). Research evaluating how humans use information in the decisionmaking process has shown that additional information typically fails to improve the quality of the decision.

Our capacity to remember and mentally manipulate information places restrictions on the amount of decisionmaking data that can be processed. Given these limitations, humans actively filter information before making a decision. Wallsten and Barton (1982), for example, found that decisionmakers, when under the stress of time constraints and multiple pieces of data, filter out the unassuming data in favor of the salient and attention-getting information. Although this process is effective in reducing the amount of data, it assumes that the saliency of the information is equal to its importance. This, however, is not always the case. Gilovich (1981), for example, asked sportswriters and football coaches to evaluate the potential of several fictitious high school football players. As expected, decisions were made based upon past performances of the athlete. When the coaches and sportwriters were informed that a professional player had come from the same town as the high schoolers, however, the rankings of the prospective players increased.

The fact that a piece of information is salient does not imply that it is important. It is extremely unlikely that a town's history of professional athletes would affect the performance of an individual football player, yet the saliency of the information still influenced the coaches' decisionmaking process. In fact, what is salient might have little bearing on the decision at hand. For instance, when firefighters know that structures are being threatened, that salient information might inappropriately affect decisions regarding firefighting tactics.

Assessing the Reliability of the Information

The process of selecting what information will be useful is constrained by yet another decisionmaking limitation. When faced with multiple pieces of information, humans tend to regard all the information "as if" it possesses the same informative value (Wickens 1992). Consider the football example above where decisionmakers assigned equal weight to both the high school performance of an athlete and his hometown, ignoring the fact that one's hometown does little to predict future football achievement. Similar situations can occur in the fire environment. When attempting to mentally predict fire spread, a firefighter might place equal importance on information about fuel type, slope, wind, and relative humidity. Realistically, the weather

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might be the single best predictor of fire spread. In this situation, the firefighter might overemphasize the effects of fuel type, slope, and relative humidity and underemphasize wind.

Making Decisions in the Absence of Feedback

Feedback is fundamental to learning and decisionmaking, for it allows us to evaluate the quality of previous decisions. In trial-and-error learning, error represents the feedback that prompts changes in future trials. Without feedback, the learning process degrades from a trial-and-error to a trial-and-trial process, a method guaranteed to produce little, if any, learning. In the fire environment, feedback concerning a particular suppression tactic might be delayed or not exist.

Feedback not only facilitates learning; it provides a benchmark against which we can evaluate the confidence we place in our decisions. Without feedback, already high confidence levels can far exceed our performance capability. Excessively high confidence levels are a consistent feature of human decisionmaking. For example, Kahneman and Tversky (1979) asked people to fill in the blanks in the following sentence. "I feel 98 percent certain that the air distance between New Delhi and Beijing is more than ___ miles but less than ___ miles*." While about one-third of the respondents identified ranges that were incorrect, they reported being 98 percent confident of their answers. What has been termed the overconfidence phenomenon (Fishhoff et al. 1977) is apparent in many facets of life. Communicating with President Truman about the feasibility of the atomic bomb, Admiral William Leahy is quoted as saying, "That is the biggest fool thing we have ever done. The bomb will never go off, and I speak as an expert in explosives" (Myers 1993). Although feedback is essential for decisionmaking, timely feedback might not be available in many complex environments. The absence of feedback will result in little learning and in confidence levels that exceed an individual's abilities. Firefighters are not immune to these problems. Whether it be an overhead team's confidence in a suppression strategy, a division supervisor's confidence in completing a section of handline, or a crew's confidence that a section of line will hold, feedback is needed not only to promote learning but also to keep confidence levels in check.

*The air distance between New Delhi and Beijing is 2,500 miles (4,023 km).

Decisionmaking Under Stress

By now it is apparent that human decisionmaking is less than perfect. The degree to which these imperfections adversely affect decisions will vary. However, there is one aspect of environment that complicates the situation—stress. The combination of these imperfections and stress can place new limitations on human decisionmaking.

Stress has been shown to adversely influence decision quality in a variety of ways. For example, stress can cause decisionmakers to inappropriately focus on only a few elements of the situation. Consider the actions of crew members on board a jet that crashed into the Everglades. Although most of the flight was uneventful, while on approach to the airport a landing light failed to indicate that the landing gear had properly extended. In reality, the landing gear was in place, but the light bulb was burned out. Unfortunately, the crew, under stress, focused on the landing light and failed to respond to an altitude warning. The aircraft slowly descended into the ground, and all of the passengers and crew were killed.

A similar stress reaction might explain the ever-increasing number of fire shelter incidents. When faced with the increasing activity of a fire and the prospect of being trapped, firefighters might focus inappropriately on a single element of the situation while disregarding other important sources of information.

Stress also decreases the human's capacity to mentally manipulate information (Davies and Parasuraman 1982) and significantly reduces the ability to consider the whole problem or other possible solutions. Wright (1974), for example, found that decision quality decreased as time constraints, distractions, and amount of obtained information increased. Stress has also been shown to narrow the ability to retrieve information from long-term memory. In stressful situations, humans are more likely to resort to well-learned or overlearned skills and behavior (Allnut 1987). Research shows that under conditions of stress, operators shift from a slow, accurate process to a fast, error-prone process (Hockey 1986). Finally, stress produces a type of action tunneling (Cowen 1952) that might cause a firefighter to continue to apply inappropriate solutions to the fire situation when other, more effective solutions are available.

Improving Decisionmaking

Poor or inadequate decisionmaking at any level of a suppression effort might have disastrous results. The ultimate goal is to appropriately address areas that might be prone to decisionmaking imperfections and stress effects. Efforts to improve fire-line decisionmaking can be aimed at three areas: decision aids, feedback, and training.

The broad classification of "decision aids" includes a variety of devices that range in complexity. For example, an aid might be as simple as a checklist that presents the Standard Fire Orders or as complex as a computerized fire-growth model. Independent of the level of complexity, these aids should address the shortcomings of human decisionmaking. In other words, an aid should provide valid predictions, minimize demands on mental manipulation, facilitate the compilation of multiple pieces of information, and provide clear decisionmaking steps for stressful situations. To judge the utility of the decision aid, however, feedback must be provided.

At times we are fortunate to see the results of decisionmaking. For example, the Yellowstone fires of 1988 provided feedback for earlier decisions. Most of the time, however, the results of decisions in the fire environment go unnoticed. For instance, a crew member who decides not to check for spotting across the line might never know that this decision resulted in more acres burned. Moreover, it is difficult to guess the impact of deciding not to burn out a piece of line. Feedback is often a luxury afforded only by a system that evaluates the progression of a suppression effort. All too often, these evaluations are provided by individuals who lack the experience and technical expertise to make a valid assessment (e.g., the media or politicians).

There are two possible sources of feedback. First, a system of peer review might serve as a potential source of feedback. For example, the interaction of less-experienced firefighters with well-seasoned firefighters would provide feedback at the time of the decision. Ideally, during the training assignment phase, evaluators could predict consequences of proposed actions.

> "Training should include the anticipation, planning, and rehearsal of actions that are necessary in stressful conditions."

Another source of feedback might take the form of a postseason peer review of selected fires. This process would, however, require the collection of enough data to allow for a sufficient review. Its largest shortcoming centers on the long delay between the decisions and the observed results. The use of simulation would be an ideal source of feedback. Braun (1993) noted that low-cost simulations on a personal computer could serve as an excellent tool for providing decision feedback.

Finally, training can be used to address shortcomings in human decisionmaking. This training, like decision aids, varies in complexity. For example, Lopes (1982) reduced the effects of decision biases by simply informing the decisionmakers that the imperfections existed. Koriat et al. (1980) addressed the human tendency to consider only information that supports a particular decision by forcing decisionmakers to consider other alternatives. For instance, they found that the accuracy of predictions given by weather forecasters improved when the forecasters were required to consider reasons why their predictions might be wrong.

When training individuals to work in stressful environments, Wickens (1992) presents three broad guidelines:

- The training should be extensive and focus on key procedures that are required. The aim is to ensure that required procedures are branded into long-term memory so they can be easily retrieved.
- Training should be as consistent across situations as possible.
- Training should include the anticipation, planning, and rehearsal of actions that are necessary in stressful conditions.

Conclusion

Decisionmaking represents one human characteristic that can greatly influence the safety and effectiveness of firefighters. Although imperfections in human decisionmaking are relatively consistent across individuals, they are not insurmountable. Simply telling people that their decisions might be adversely influenced by these imperfections might serve to minimize their effects. Moreover, the use of innovative decision aids, simulations, training packages, and systematic feedback can only serve to improve firefighter performance. Ultimately, we must realize that the decisionmaking process is less than perfect, but with the appropriate research, technology,

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training, and feedback, the process of fire line decisionmaking can be enhanced.

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Attitude Check

Bill Fish

Much has been said in recent months about having a "passion for safety," holding individuals directly accountable for safety, and strengthening our "sensitivity to basic safety standards so they permeate every fiber of our strategy, tactics, and basic fire operations." These are certainly basic tenets of a fire suppression ethic where attention to safety is of paramount importance.

Our training materials, handbooks, and manuals all include strongly worded references to safety. For example, The Fireline Handbook states, "Each individual and especially supervisors have and must redeem their safety responsibility" (NWCG 1989). There is virtually no place where our attention to safety is left out or not emphasized.

We know how to do the suppression job safely. There was little learned during the last fire season to drastically change our fundamental tactical approach to fighting wildfires. Our approaches to teaching firefighting techniques are solid.

To truly focus on our "passion" for safety, however, there is one aspect of our daily awareness that needs attention. Our emphasis on doing this dangerous job safely needs to be fine-tuned with a discussion about incident attitude or outlook and an awareness that some organizational situations, physical difficulties, and inconveniences have a profound effect on our frame of mind and our ability to focus attention on safe processes. We know what safety is, we know what things to watch out for, but our ability to concentrate on this aspect of our wildfire suppression responsibility often is impaired by barriers that are a part of every incident we get assigned to—from the smallest lightning fire to the largest project fire.

> Firefighters need a positive attitude to think clearly, act decisively, and do their jobs safely.

To be sure, firefighting operations have come a long way over the years. We now have some conveniences that not too many years ago were unheard of or impossible to access. Attention to crew well-being is constantly a point of emphasis. We have guidelines for rotating crews between rest and recreation and active duty—guidelines that are an important aspect of fire resource management. Even with these improvements, however, we still need to deal with such intangible factors as crew morale, frame of mind, and the very strong link between these psychological states and our ability to concentrate on doing the job safely.

Have you ever been dispatched to a fire thinking "Why didn't we get sent to Arizona (or wherever) instead of that crew? They got the last good fire, and we always seem to be getting the bottom of the barrel when it comes to fire assignments. What's wrong with those people in dispatch? They need to do a better job of assigning the good fires." Or have you ever been dispatched to a fire only to find out that someone else had been there before your crew and barely scratched a fire line? When the fire kicks up again, crosses the line, and makes a run, you might grumble, "What's the matter with those folks; can't they do the job right? Why do we have to come back and do the job they should have done in the first place?" Or, have you ever been left out on the line past your scheduled pickup time because of human error? Did you ever have trouble getting equipment from supply? These situations are not that uncommon over the course of a fire season for many reasons. Sometimes one or more of these events can occur over the course of a line shift.

Now how do you suppose these events (or combination of events) impact your ability to do the job safely? The answer to this question might be that it shouldn't have an impact, but the real answer is that it probably does. It takes special attention and vigilance not to allow these common occurrences to influence or mask attention to safe firefighting tactics. Being physically tired, emotionally out of sorts, or even uptight about the coming assignment are potential indicators of a poor frame of mind that need attention.

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Of course, we as firefighters have the right and responsibility to point out a mismanaged *situation*. Knowing we have a chance for feedback to our supervisors and that they will respond to our feedback should also improve our attitude in the long run. Similar to how we provide post-incident crew and individual performance appraisals, we need to ensure that there is a feedback loop to critique incident management. Such a process allows crews assigned to any incident the opportunity to review their individual incident experience and know their review will feed back to the incident management structure and responsible line officer.

In closing, I urge that all of us continue to be aware, take stock of our attitudes about the duty ahead, and help coworkers maintain a positive attitude so their personal safety won't be at risk. Teamwork is an integral part of wildfire suppression activities. Teamwork is needed to do our job safely. Incident attitude needs to be positive so that it does not impair our ability to think clearly and act decisively.

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Warning! Some Fire Shelter Training Techniques Are Dangerous

Richard J. Mangan

Several years ago, a national firefighter magazine described a "live-fire" training exercise for wildland firefighters. In this training, firefighters deployed fire shelters and went inside; then a practice fire was allowed to burn over them.

Ted Putnam, fire shelter specialist at the USDA Forest Service's Missoula Technology and Development Center (MTDC) in Missoula, MT, strongly opposes these types of training. "Firefighters have received burns and narrowly avoided serious injury or death during such training," he said. "There is too great a risk to the safety of our firefighters."

Although MTDC discourages live-fire training, crews continue to use it. For more realism in training, some crews occupy shelters near burning brush piles. This achieves realism but is still dangerous. Steps must be taken to ensure that a trainee doesn't panic, leave the shelter, and run into the fire. Safeguards should include fire suppression equipment such as an engine and a radio link with the trainee. For this training only, a new or fully serviceable fire shelter should be used. Do not use shelters taken out of service.

"Even with engines ready to spray water, problems have occurred, so we recommend even these more controlled fire shelter training experiences not be used," Putnam said. "The point is that crews have devised many realistic training sequences for shelter use over the years, and even with what appears to be foolproof safety precautions, things have gone wrong," he explains. "When practice fires are allowed to burn over people in shelters, there is even less control and, therefore, greater risk."

Putnam encourages training methods that emphasize hands-on deployment of the shelter in a safe learning environment. He says it's important that firefighters learn to deploy their shelters in less than 25 seconds, essential in an actual deployment. To assist agencies in this training, MTDC has designed a "practice" fire shelter based on an idea developed in California. (See previous article on page 12 by Kevin Lee—"A Potential Life Saver—Training With a Practice Fire Shelter"—for information about ordering and using the practice shelter for training.)

Putnam recommends coupling hands-on deployment with "visualization" to help firefighters mentally prepare for the greatest variety of conditions likely to occur in an actual entrapment and deployment. (The publications and video referred to in Lee's article discuss this and other current training techniques.)

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Does Firefighting Pose Reproductive Risks?[1]

FOREST SERVICE TECHNOLOGY & DEVELOPMENT PROGRAM

Brian J. Sharkey

Wildland firefighters face many hazards in the conduct of their duties. Among these hazards are potential reproductive risks—for both male and female firefighters. Exposure to smoke, toxic fumes, and heat—as well as other factors—can threaten an individual's ability to conceive or bear a healthy child.

Most of us would assume that smoking cigarettes is a possible model for the hazards of smoke exposure because we know cigarette smoking has been linked to low birth weights. Statistics show the birth weight of infants born to mothers who smoke (depending upon how much they smoke) averages 6 ounces (170 g) less than that of infants born to mothers who are nonsmokers. Also, the incidence of spontaneous abortion, stillbirth, pre-term birth, cleft palate, and sudden infant death syndrome may also be increased in pregnant women who smoke (Berkow 1992). However, there is little data concerning the risks of exposure to toxic chemicals at levels measured in the breathing zone of wildland firefighters.

Carbon monoxide (CO) has the potential to affect the developing fetus, but, aside from lowering birth weight, CO has not emerged in studies of smokers who are regularly exposed to much higher levels of the gas than firefighters. Specifically, the blood of smokers regularly contains 5 to 10 percent carboxyhemoglobin (COHb), but studies of wildland firefighters have found few instances where exposure would raise COHb levels to 5 percent. In a recent study of smoke exposure at wildfires (Reinhardt et al. 1995), carbon monoxide exposure averaged 4.1 parts per million (ppm) over the workshift. This is far below the 35 ppm permissible exposure limit recommended by the National Institute for Occupational Safety and Health. The 35 ppm limit is designed to keep COHb levels below 5 percent, so it is likely that COHb levels for firefighters in this study were usually below 2 percent. Moreover, the exposure of firefighters is intermittent, episodic, and seasonal, while that of cigarette smokers remains consistently high, day after day.

Researchers have been concerned about firefighters' exposure to extreme heat, which has been linked to male infertility and possibly to birth defects in the offspring of exposed mothers. Maternal illness with prolonged high fever has been associated with birth defects, but while precaution against extreme heat remains prudent, research on pregnant women and their use of saunas, for example, has not revealed birth defects. And while wildland firefighting has the potential for heat stress, studies of firefighters have not indicated severe heat problems, especially when firefighters are fit, acclimatized, and hydrated. The low humidity and air movement of the burning season enhance evaporative and convective cooling and lower the risk of heat stress.

Firefighters who are pregnant, breast feeding, or attempting to conceive should consult their physician if they are concerned about the reproductive risks of fire suppression. It may be useful to know that case studies of pregnant runners have revealed that those who remain active throughout most of their pregnancy have statistically fewer birth difficulties or defects than inactive pregnant women.

The U.S. Supreme Court, in a precedent-setting case, ruled that pregnant workers who are physically capable of performing the duties of the position may, at their discretion, remain in active duty (United Auto Workers v. Johnson Controls, 1991). While it is not the obligation of the employer to protect the fetus, the employer may be able to assign the firefighter to less hazardous duties upon request. Pregnant firefighters who, on the advice of a physician, cannot continue working in any capacity, should be granted leave in accordance with existing pregnancy or other leave policies of the agency having jurisdiction.

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[1]Dr. Sharkey's original article—"Reproductive Risks of Firefighting"—appeared in "Health Hazards of Smoke," published by the Missoula Technology and Development Center, Missoula, MT.

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A nonprofit network—Women in the Fire Service (WFS)—has a "Reproductive Safety Information Packet" available. The WFS maintains a resource and data bank on issues specifically pertaining to women firefighters. Their address is P.O. Box 5446, Madison, WI 53705. Telephone or Fax them at 608-233-4768.

Summary

While typical exposure of firefighters to smoke and heat is not likely to cause reproductive problems, individuals should always consult their physicians to help them make decisions about their own reproductive health. Pregnant women may decide to request reassignment or leave, if necessary. And those who remain on the job should try to avoid excessive exposures to smoke and heat.

NWCG Adopts Flagging Standard

The National Wildfire Coordinating Group (NWCG) has adopted a "flagging standard" for wildland firefighting that is consistent with the standard adopted by national safety agencies for safety and hazard designations. Specific colors are to be used to denote **hazards** and **safety** features:

Hazards—Flag hazards with ribbon that has alternating yellow and black diagonal stripes.

Safety—Flag escape routes and safety areas with lime green flagging.

Additional information can be written in ink or with a grease pencil on the ribbons. Flagging must be taken down when the message is no longer appropriate.

For more information on any of the studies reported here, please contact Brian J. Sharkey, MTDC, Bldg. 1, Ft. Missoula; Missoula, MT 59801; tel. 406-329-1043.

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Guidelines for Contributors

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Fire Management Notes (*FMN*) is an international quarterly magazine for the wildland fire community. *FMN* welcomes unsolicited manuscripts from readers on any subject related to fire management. (See the subject index of the first issue of each volume for a list of topics covered in the past.)

Because space is a consideration, long manuscripts are subject to publication delay and editorial cutting; *FMN* **does** print short pieces of interest to readers.

Submission Guidelines

Authors are asked to type or word-process their articles on white paper (double-spaced) on one side. Try to keep titles concise and descriptive; subheadings and bulleted material are useful and help readability. As a general rule of clear writing, use the active voice (e.g., Fire managers know . . . **not** It is known . . .).

Submit articles to Donna Paananen, Editor; *Fire Management Notes*; USDA Forest Service; North Central Forest Experiment Station, 1407 S. Harrison Road, Room 220; East Lansing, MI 48823-5290; telephone 517-355-7740. Internet: FSWA/S=D.Paananen/OU1=S23L03A@MHS.ATTMAIL.COM. Data General:S23L03A. Include with the paper copy the complete name(s) and address(es) of authors as well as telephone and Fax numbers and e-mail information. If the same or a similar article is being submitted elsewhere, include that information also.

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Yellowjackets: The Little Danger Under Your Feet

Billy J. Terry

A firefighter almost died from a reaction to multiple wasp stings while working on the September 1994 Idaho City Complex. Another firefighter, with a known allergy, was swarmed by yellowjackets and suffered little more than discomfort and 1 day lost from the fire line.

The different results most likely can be attributed to differences in preparation for a known risk on the fireline: stings by insects, particularly from members of the wasp family, including yellowjackets.

Fire camp medical unit records show more treatment given for stings than any other fire-related injury except sore feet. Most stings give fire personnel minor discomfort. But research by the American Academy of Allergies and Immunology shows more than 2 million people in the United States are highly reactive to wasp and bee stings and that at least 50 people will die each year from anaphylactic shock resulting from a sting. The number of people who are highly reactive may be much higher than these figures indicate. Victims found dead outdoors are sometimes wrongly diagnosed as having died from heart attacks (Dale 1991).

Billy J. Terry is a rural fire defense coordinator for the USDA Forest Service, Northeastern Area, State and Private Forestry, Radnor, PA.

> Almost anyone can have an allergic reaction to a yellowjacket sting.

Why Firefighters Meet Yellowjackets

Yellowjackets are more likely to survive a wildfire than other types of wasps because most species build their nests in the ground. When firefighters construct line, they may unintentionally disturb these nests.

During a fire, yellowjackets live in a disrupted world. Food is scarce, so the yellowjackets have to forage a larger area. To compound the problem, forest fires in the West reach their intensity from July to September. Yellowjackets and other wasps actively collect food for winter during this time and are easily disturbed and can become very defensive.

Firefighters increase the risk of being stung as they pound the ground constructing fireline and use chainsaws to fell trees. The disturbed insects quickly attack when they feel the vibrations through their feet. Bright yellow fire shirts may resemble food to wasps and yellowjackets, making fire personnel targets. And when food is around because people are eating meals, it may make firefighters even more attractive to yellowjackets.

Two Different Stories

In September 1994, two firefighters were stung with very different outcomes on the same day during the Rabbit Creek Fire of the Idaho City Complex.

One almost died after reacting to multiple wasp stings. Apparently, neither the firefighter nor her crew was prepared to deal with reactions to stings. During the 100-mile helicopter flight to a hospital in Boise, ID, medics injected her repeatedly with the stimulant epinephrine to counter the allergic reaction. Because of the fast action by the medics, she survived, but hospitalization was required.

Irritated yellowjackets are a hazard to fire crews both constructing line and doing mop-up. Photo: Anne Bohnet, USDA Forest Service, NFES, Radnor, PA, 1994.

Continued on page 24

Pounding the ground during line construction or running chainsaws may encourage yellowjackets to attack in force. Photo: Anne Bohnet, USDA Forest Service, NFES, Radnor, PA, 1994.

The other firefighter was digging line with a Pulaski when the tool penetrated a nest in the ground. Within seconds, he was covered with yellowjackets and stung five times. Knowing he was highly allergic, he carried an anaphylactic kit (ana-kit) in his pack, so he was ready to immediately inject himself in the leg. The result was 1 day lost from the fire line but no lingering ill effects. Preparation made a big difference.

What Is an Allergic Reaction and Who Is Susceptible?

The sting of a yellowjacket, like that of most bees or wasps, causes the body to produce an antibody called IgE. To cause a severe reaction such as shock, a second sting some time later is normally required. Once the antibodies have been produced, they are available in the body to react to the sting venom.

Reactions can range from mild to full shock (Dale 1991). Antibody production is increased greatly in highly allergic individuals. In this situation, symptoms could include dizziness, difficulty in breathing, and the need to lie down. The tongue could swell and the air passages close. In a highly allergic person, about 10 minutes will pass between the sting and a coma. In this case, a kit must be readily available.

Almost anyone can have an allergic reaction. This happens for two reasons. First, many people are not aware that a previous sting has produced antibodies that could result in allergies. Second, a highly fatigued firefighter might be especially susceptible to a severe reaction. Skin testing has been used to try to determine allergic levels, but these tests are not reliable. In short, there is no real way to know who can be allergic to such stings.

How To Minimize the Possibility of Yellowjacket Attack

- Supervisors should include instructions at the start of a shift to watch for increases in the number of yellowjackets in an area. This normally indicates that a nest is close and caution should be used when running chainsaws or disturbing the ground.
- When wasps are known to be around, keep shirt sleeves rolled down, put pant legs in boots, tuck in shirttails, and keep the neck guard down.
- Avoid using aftershave lotion, perfumes, hair sprays, tonics, suntan lotion with scents, or scented deodorant. Any of these can attract the insects. Most insect repellents are not effective against wasps; some scented repellents even attract them.
- If a wasp enters a vehicle, the driver should pull over immediately, roll down all the windows, and leave the vehicle until the insect escapes.
- When eating meals in areas where yellowjackets are active, place a small amount of anything containing sugar where it can be easily reached just outside the dining area. This could be soft drink in an open container, broken cookies, or a half-eaten apple. The insects will be attracted to the sugar and less likely to demand the firefighters' meals.

Steps to Take Before Going on the Line

- Equip at least one emergency medical technician on each fire crew with an ana-kit.
- Prior to going out on the fireline, instruct those known to be allergic, crew leaders, and squad leaders in how to use ana-kits and how to recognize the symptoms indicating shock. These individuals should also know who on the crew has a history of allergic reactions.

- All known to be allergic to wasp or bee stings should carry an ana-kit in their backpacks and tell their supervisors. Individuals known to be allergic should be asked to obtain a kit from their physician before going out on the fire line. Their physicians should also give them instructions for injecting themselves to mitigate the reaction to a sting.

When a Bee or Wasp Stings

- Clean the area with soap and water or an antiseptic solution.
- Apply an ice pack or cool compress to slow venom absorption and lessen local swelling.
- Watch for an allergic reaction such as hives or any swelling of the tongue or throat. This would include any difficulty in breathing.
- Use the ana-kit if two or more of the following symptoms of anaphylaxis occur: hives; swelling of the lips, eyelids, or tongue; tightening in the chest; wheezing; difficulty breathing; difficulty swallowing; hoarseness or thickened speech; abdominal pain; nausea; vomiting; dizziness; marked weakness; confusion; or feeling of impending disaster.
- If the symptoms become more severe, immediate medical attention is required. Maintain the airway. Use artificial respiration and a plastic airway device if necessary until a physician or qualified paramedic can administer specific medications (Putnam 1977).

Firefighters will continue to be stung on the fire line. Most of the time, this will amount to nothing more than a slight discomfort for a short period. However, there will always be the chance it will be something far more serious. Being prepared and aware of the potential problem is the key to eliminating deaths caused by severe allergic reaction.

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Aviation Management Triangle

John Chambers

This aviation management triangle (fig. 1) represents the essential elements of sound, professional aviation management. Its objective is to provide safe, cost-effective, and appropriate aviation services in support of natural resource protection and management.

Figure 1—*The new aviation management triangle has safety as its foundation.*

As depicted in this triangle, the foundation of aviation management is safety. If the mission cannot be accomplished without compromising safety, we must say no and explain safety concerns. We can ensure an acceptable level of risk through sound risk management.

As shown on the left of the triangle, we strive for cost-effective aircraft use. We must question requests that are not cost-effective, explain why, and recommend an economical alternative.

Finally, we should use the right aircraft for the situation. We must question requests for the use of inappropriate aircraft, explain why a particular aircraft is not the right one for the job, and recommend a better way of accomplishing the mission. Again, we do what's right!

By keeping the aviation management triangle in mind as we make decisions, we will stand up for aviation management!

John Chambers is assistant director (Aviation Management), USDA Forest Service, Fire and Aviation Management, Washington, DC.

1994 Wildfire Prevention Awards Presented

Rod Kindlund

The Nation's highest award for wildland fire prevention, the Golden Smokey, was presented to three recipients on May 17, 1995, by Forest Service Associate Chief David G. Unger. This year's recipients were Elsie W. Cunningham, acting national fire prevention officer for the USDA Forest Service in Washington, DC; Donna Paananen, technical writer-editor at the Forest Service's North Central Experiment Station in East Lansing, MI; and Bill Clark, national fire management specialist for the USDI National Park Service in Boise, ID.

The objective of the Golden Smokey Bear Award is to recognize individuals and organizations for their outstanding service in wildfire prevention. These activities must encompass national publicity and have been sustained over a period of 2 years or more.

Elsie Cunningham was recognized for her efforts as national program manager for the Cooperative Forest Fire Prevention (CFFP) program. In presenting the award, Associate Chief Unger said, "You have demanded excellence within the Smokey Bear program and have enhanced its quality." She has also implemented a centralized, catalog ordering system for Smokey Bear, which has eased the contracting, receiving, and distribution of prevention education materials.

> "The Forest Service and our sister agencies have reason to be proud of these individuals"—
> Chief Jack Ward Thomas.

Donna Paananen was recognized for her involvement in local, regional, and national fire prevention programs and publications. Donna was a key player in the national Smokey Bear 50th Anniversary, for which she wrote many fire prevention speeches and articles. As part of this effort, Donna was general manager and contributing editor for a commemorative issue of *Fire Management Notes*. She has since become editor of this periodical, published by Fire and Aviation Management in Washington, DC.

Bill Clark was awarded the Golden Smokey for his efforts in fire prevention on behalf of the National Park Service. His fire prevention analysis system has been adopted by all USDI resource management agencies and is part of the Forest Service fire prevention training conducted at NARTC in Marana, AZ. Because of his encouragement, the National Park Service became an active participant in the celebration of Smokey Bear's 50th Anniversary.

"The Forest Service and our sister agencies have reason to be proud of these individuals," stated Chief Jack Ward Thomas. "They exemplify the essence of unselfish participation in wildfire prevention at a time when that emphasis is changing very rapidly. As we move into the 21st century, fire prevention, as well as other forest man-

Associate Chief David Unger poses with this year's Wildfire Award recipients. (From left: Bill Clark, Donna Paananen, David Unger, Elsie Cunningham) Photo: Yuen-Gi Yee, USDA Forest Service, PAO, Washington, DC, 1995.

Rod Kindlund is a visual information specialist, USDA Forest Service, National Fire Prevention Operations, Clovis, CA.

agement programs, will have to continue to integrate with natural resource values."

"The recipients of this award have spent their careers caring for the land on which so many Americans live and recreate," the Associate Chief said, "and this is one way that we can show our appreciation. Fire prevention in the wildland-urban interface has become a real challenge for today's resource agencies. Their dedication to interagency cooperation is an example to resource managers nationwide."

Silver and Bronze Smokey Bear Awards were presented earlier to 20 individuals and groups. Recipients of the Silver Smokey statuettes must have provided at least 2 years of outstanding service in regional or multistate fire prevention efforts. They are as follows:

- Images in Motion, Lee Armstrong and Kamela Portuges, Sonoma, CA.
- Peter Carl Martin, USDA, Forest Service, Mt. Hood National Forest, Gresham, OR.
- Alfred and Sylvia Grimes, Madbury, NH.
- Wesley L. Wells, Georgia Forestry Commission, Macon, GA.
- Baltimore Orioles Baseball Team, Baltimore, MD.

Bronze Smokey Statuettes are given for at least 2 years of local and/or statewide fire prevention efforts. They were presented to the following:

- Dan Whittaker, USDA, Forest Service, Tahoe National Forest, Nevada City, CA.
- Beverly S. Stout, Indiana Department of Natural Resources, Indianapolis, IN.
- James T. Gowdy, New Jersey State Forest Fire Service, Mays Landing, NJ.
- James Downie, Maine Forest Service, Augusta, ME.
- Jon Agner, Missoula County Fire Protection Assn., Missoula, MT.
- Fred Judd, USDI, Bureau of Land Management, Idaho Falls, ID.
- National Automobile Museum, Reno, NV.
- Manning, Selvage & Lee Advertising, Los Angeles, CA.
- Chuck Robinson, USDA, Forest Service, San Bernardino National Forest, San Bernardino, CA.
- Tim Whitten, Alabama Forestry Commission, Montgomery, AL.
- Department of Agricultural Communications, Texas A&M University, College Station, TX.
- Jule Huffman, West Virginia Division of Forestry, Milton, WV.
- Jacob C. Bruckler, New Jersey State Forest Fire Service, Trenton, NJ.
- Glen's Markets, Inc., Gaylord, MI.
- WMUR-TV, Channel 9, Concord, NH.
- WGME-TV, Channel 13, Portland, ME.
- WQCB-FM Radio (Q106.5), Brewer, ME.

Nominations for these annual awards are solicited each year from field units of the Forest Service, State Foresters, and cooperating natural resource agencies and are due in October. Selection of the award recipients is made during the first meeting of the CFFP Executive Committee in the new year. ■

"If a Tree Falls"—Safety Video Now Available

The Publications Management System (PMS) now has available the video "If a Tree Falls." It provides information for firefighters or other woods workers on safety related to falling trees, snags, or green trees. "If a Tree Falls" can be used as a training aid, incorporated into courses, or used as a basis for safety meetings. The tape program provides some background on accidents involving falling trees and recommends some practical ideas to help prevent them.

The program was produced by the Boise National Forest in cooperation with the National Wildland-Fire Coordinating Group's Safety and Health Working Team. The latter convened a Snag Hazard Review Team, headed by Jerry Schmidt, which made the production of the video a priority. Boise National Forest lost a firefighter in 1992 when a snag fell from within the fire and struck and killed Julie Young, who was working on a line over 90 feet away during an initial attack on the Silver Creek fire near Cascade, ID.

Snags have always presented firefighters with a "silent threat"—often present regardless of terrain, weather, or fire behavior. That threat is real during initial attack on small fires, while conducting operations on large fires, on "hot" segments, and in "quiet" areas—even during mop-up. Where trees are present, snags are a threat. They are one of the leading causes of injuries and death to firefighters on the line. ■

Fire Camps on the Boise National Forest Recycle

Darrel Van Buren

A column of smoke is spotted by the lookout. A radio call goes to the forest dispatcher and crews are soon heading towards the rapidly growing column. First reports indicate the fire has the potential of becoming a major incident and an overhead team is ordered. Another "big one" has burst in the Northwest and the firefighting machine comes to life.

Everyone associated with fire is familiar with this scenario and the days that follow—long working hours, eating and sleeping in tents—we all know the scene.

So what does the firefighting machine have to do with recycling? Fire camp has some of the same problems as a permanent city, including transportation, health care, shelter, and garbage. Fire managers are constantly looking for ways to minimize the impact of fire "boom" towns on the surrounding communities. They've done a pretty good job with one exception—garbage.

Garbage has to go somewhere and usually that's the local landfill, right? Consider that in rural areas, a fire camp can have a higher population than the neighboring town has. Also, a fire of any magnitude and duration could literally take years of use from the landfill, edging it closer to its planned capacity. Any former resident of fire camp can attest to the mountains of waste generated. Comments often heard are, "Why can't we use some of the cardboard?" or "It's such a waste to throw things away."

Boise NF Recycles

These comments generated action on the Boise National Forest. Over the last 8 years, the Boise has had its share of fire boom towns, and we decided to do something about it.

In 1993, a Fire Camp Recycling Plan was drafted. It outlines the duties of the recycling liason officer (RLO), materials to be recycled, and basic requirements of establishing a recycling program in fire camp. The plan was written to minimize impact to the overhead team and cost to the incident but capture as much recyclable material as possible.

Preplanning, coordination, and education are the key elements to a successful program. The forest dispatcher, the local recycling center or collector, and the recycling liason officer(s) must be briefed of duties and the proposed action plan before the fire season starts.

Implementation begins with the forest dispatcher notifying the RLO when an overhead team is ordered.

A view of 800 pounds (362 kg) of compressed aluminum cans. A total of five of these bricks were collected by the Boise National Forest during the 1994 fire season. Photo: Darrel Van Buren, Boise National Forest, 1995.

Darrel Van Buren is a civil engineering technician, USDA Forest Service, Boise National Forest, Boise, Idaho.

What Recycling Efforts Worked?

- Coordinating for recycling needs and monitoring the recycling program by the recycling liason officer (RLO), the facilities unit leader, and the camp manager.
- Marking collection containers clearly for recycling use and ensuring they are a different type and color than trash cans. For convenience, locating recycling containers and trash containers together.
- Informing fire crews of the recycling program at morning briefings and in written briefings. Encouraging all personnel to participate by separating tin, aluminum, glass, and plastic containers in spike camps and at the Incident Command Post.
- Having camp crew collect recyclable material from recycling containers. (Many of the crew enjoyed participating in the recycling effort.)
- Posting information on bulletin boards about the recycling program and updating daily the total pounds collected. Also posting general facts (including trivia) about recycling.
- Making the program as user friendly as possible, minimizing the impact to the overhead team and the cost to the incident. Using but not overextending the resources in place.
- In the Boise National Forest situation, using personnel from the Idaho Empowerment Program as some members of the camp crew. (The empowerment program helps the homeless develop job skills and provides other services to help enrollees reenter the work force.)

What Recycling Efforts Need Rethinking?

- Relying on empty supply trucks (returning to town from camp) to haul material to the recycler. Trucks were in short supply because of the large fire activity on the Boise and Payette.
- Not installing enough collection bins for recycling nor enough signs around camp.
- The RLO not working closely enough with the facilities unit leader to keep that person informed.

To Improve Fire Camp Recycling

We recommend that other areas consider a similiar recycling program and that they request from public service groups a list of potential and reliable people to interview before the season. Such preplanning allows a chance to screen applicants—they can ask and organizers can answer questions. We also suggest that you:

- Have a preagreement with a hauler or designate a specific vehicle for hauling. Or, with the trash disposal contractor, try to coordinate recycling with regular trash pickups. The contractor may be able to haul recycled material to the recycling center.
- Prepare recycling signs and containers before fire season begins.
- Locate bins at convenient areas in camp (e.g., near crew sleeping quarters, where briefings and meetings occur, at supply stations, near washing and shower areas, where personnel eat, and near unit tents).
- For a variety of reasons including easy pickup and hauling, line all containers with plastic bags.
- Bundle, bag, or box all recycling material (weight should not exceed 45 pounds (20 kg).
- Locate the main collection area near the supply station or kitchen. Allow for a lot of room.
- Make disposal and collection as user friendly as possible.

At the initial forest briefing, the RLO is introduced and the recycling plan reviewed. The RLO coordinates with the logistics chief as well as with food, supply, and facility unit leaders to minimize impact to the overall fire effort. The RLO directs, coordinates, and supervises recycling activities and personnel in fire camp.

From July 20 through October 30, 1994, the Boise National Forest experienced wildfires and rehabilitation efforts on 300,000 acres (121,458 ha). The activity generated more than 81,000 pounds (36,652 kg) of cardboard, 8,700 pounds (3,937 kg) of plastic (68,000+ water bottles), 3,775 pounds (1,712 kg) of aluminum cans, and 1,500 pounds (679 kg) of glass. This is an estimated 300 cubic yards (230 cm) that did not go to the local landfill. In addition to recovery of recyclable material, over $3,400 was returned to the United States Treasury from the receipts.

We felt that overall our efforts have been very successful (see box). And we know where we need to make improvements in the future. Above all, we felt that because fire and garbage can impact our environment so drastically, maybe our efforts to recycle will help lessen some of these impacts. ■

Regional Analysis of Haines' LASI

Brian E. Potter

In 1988, Donald A. Haines of the USDA Forest Service presented a method for predicting fire risk. It relies on properties of the lower atmosphere, namely temperature lapse rate (a measure of stability) and the difference between temperature and dewpoint, i.e., dewpoint depression (Haines 1988)[1]. He called this a lower atmosphere severity index, or LASI. Haines noted that temperature lapse rate and dewpoint depression receive equal emphasis in his system, but that this might not be the best approach. Recent results indicate that temperature lapse rate is not important in the Southeast, and it is possible that neither lapse rate nor dewpoint depression is important in the South Central United States.

I examined fire weather and climatological data from the conterminous United States for the period 1971-84, dividing the Nation into six zones as shown in fig. 1. For each zone, I used statistical analysis of variance to test the total LASI and each of its components for the ability to distinguish fire weather from "typical" weather, i.e., climatology. The results show that the index is capable of distinguishing fire weather for all zones except zone 5 (Arkansas, Kansas, Louisiana, Missouri, Oklahoma, Texas, and parts of eastern Colorado and New Mexico). In this zone, the data did not reveal a significant difference between climatology and fire weather.

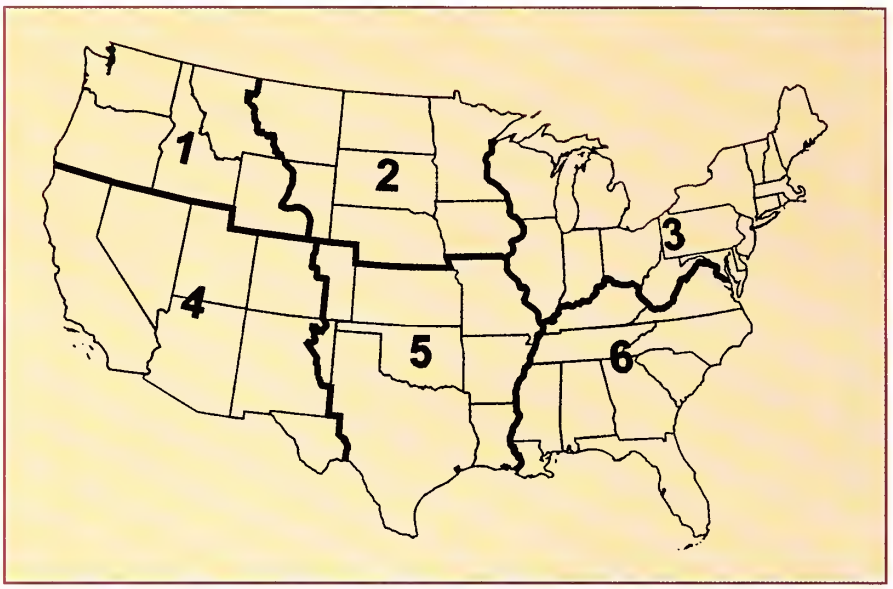

Figure 1—*Boundaries of the zones used for analysis of the LASI.*

On fire days, the LASI's lapse rate component exceeds its climatological value in all zones except 5 and 6, while the fire day dewpoint depression component exceeds climatology in all zones except zone 5. In other words, the dewpoint depression component of the LASI alone is sufficient to indicate fire weather in zone 6.

Zone 5 had the fewest fires of all the zones in this study, and it is possible that the LASI does work there, but the statistical test used did not find an appreciable difference between fire and climatology. Zone 6, on the other hand, had more fires in it than any other zone in the study, but most of them were in North Carolina and Florida. These differences are due to the availability of fire data for the time period I examined. Because the zone boundaries are purely artificial, there may be States in zone 5 where the LASI works, and States in zone 6 where it does not. This could be determined only through a State-by-State analysis.

I am currently evaluating an alternative measure of fire risk, one that may be more useful in zone 5. This new measure uses the difference between actual temperature and dewpoint temperature at the surface of the earth and adjusts the difference for the influence of elevation. It differentiates fire weather and climatology in most of the conterminous United States and Alaska, but fails to differentiate in Hawaii and zone 6, according to the same statistical testing methods used for the LASI. Details of this method may appear in a future issue of *Fire Management Notes.*

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Brian E. Potter is a research meteorologist for the USDA Forest Service, North Central Forest Experiment Station, East Lansing, MI.

[1]*Editor's note: Haines' LASI was also discussed in* Fire Management Notes, *1992-93, 53-54(3): 23-26 by Edward A. Brotak.*

We Are Each Responsible

I expect that all of us in fire management who experienced the 1994 wildfire season, the most demanding on record, will remember it for the rest of our lives. It is with a deep sense of personal loss and professional concern that I reflect on those 34 individuals who lost their lives fighting wildfires across our Nation. We must learn from this huge loss in human lives. We are each responsible for ensuring that we never again suffer such tragic losses.

A few statistics quickly clarify the situation the agency faced in 1994. More than 69,000 wildfires burned nearly 4 million acres (1,600,000 ha) nationwide. At the peak of the fire season, 28,000 men and women were working on the suppression effort, along with some 4,000 military personnel. The dollar cost to the Forest Service alone exceeded $700 million in that single year.

We can take pride in knowing that out of thousands of fires that occurred in 1994, only a very few fires escaped and caused problems. We should take credit for our past successes. However, we're still in the fire protection and suppression business. We continue to have the responsibility of reinforcing the tenets of the 10 Standard Fire Orders and 18 Situations that shout "Watch Out!" The abbreviation L.C.E.S. needs to be reviewed and implemented: *L*ookouts, *C*ommunications, *E*scape routes, *S*afety zones.

As we face each future fire season, there are some positive steps we can take and reminders of behaviors that we expect. For managers and line supervisors these include:

- Managers must ensure that each firefighter knows that safety is paramount throughout all incidents.
- Managers must be involved in and participate in presuppression, suppression, monitoring, and followup activities.
- Managers must ensure that safety evaluations are included when planning strategy and tactics and that regular reevaluations of safety are made.
- Managers must ensure that work and rest guidelines are followed.
- Supervisors must be able to talk with their crews and adjacent crews; all must have access to operational and fire weather information.

Both managers and firefighters will take the following steps:

- Managers and firefighters must be able to attend key training courses and get the experience they need to improve knowledge and skills.

Firefighters have the following responsibilities:

- All firefighters must be responsible for their own personal safety and be alert to help those around them. If firefighters cannot mitigate or eliminate an unsafe situation, they must communicate the problem to those who can.

Mary Jo Lavin

- Communications between firefighters must be maintained; when necessary, tactics will be adjusted to provide appropriate communications.
- Firefighters must continue to be important team members during safety evaluations and accident investigations. Their role is critical to ensure safety issues are paramount on all incidents.
- Firefighters must know, without question, that they will not face repercussions for making themselves and others safe.
- Firefighters must constantly remind themselves that fire behavior can be so extreme that timeframes for decisionmaking are very short.

Let us all remember, no wildland fire, even those that threaten structures or improvements, is worth risking death or injury.

We are each responsible for ensuring that what happened in 1994 never happens again.

Mary Jo Lavin, Ph.D., Director
USDA Forest Service
Fire and Aviation Management

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